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ABSTRACT

Intended for college bound students, this booklet explores textbook components to help students in their approach to studying technical information. After defining technical material and describing how to recognize it, the booklet discusses (1) symbols, (2) equations, (3) formulas, (4) theorems, (5) placement of symbols in textbooks, (6) tables, (7) illustrations, (8) line and bar graphs, (9) pictographs, and (10) pie charts. (HTH)

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HOW TO READ TECHNICAL TEXTBOOKS

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So You're Going to College—We Can Help

So you're going to college—and you think you may need some help with the experience. You have a lot of hard work facing you, but we think we can help you with some remedies for a few of your biggest headaches.

First, there's a kind of guidebook called, "HOW TO GET THE MOST OUT OF YOUR COLLEGE EDUCATION." And we really mean it—you'll get the MOST out of it if you put the ideas in this booklet to work for you. It talks about learning, about selecting your classes, about using your time wisely, about taking good class notes.

There will be more for you to read in college than at any other time in your life. And the better you read and comprehend, the more interesting and fulfilling your time in college will be "HOW TO IMPROVE YOUR READING SKILLS" zeroes in on the seven steps to help you improve your reading and comprehension, so reading becomes a joy instead of a chore.

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Next, exams. They can petrify you—even if you've studied your heart out. Well, we have a great booklet designed to make sense out of the complicated process of preparing for and taking exams. It's called, naturally enough, "HOW TO PREPARE FOR EXAMINATIONS," and it's chock-full of proven methods to get you started on the road to the big A.

College students are increasingly being asked to tackle more and more highly technical material, and the new booklet "HOW TO READ A TECHNICAL BOOK" has been prepared to help you meet that challenge. It's a step-by-step guide to reading and understanding technical material that could help you on the Dean's List—and keep you there!

These booklets should help you solve some of your college problems; for the others, we'll wish you *good luck!*

To order any booklet for yourself, just drop us a note at AAP STUDENT SERVICE, One Park Avenue, New York, NY 10016. For multiple orders, just have your teacher or guidance counselor ask for the Order Form Booklet.

How To Read Technical Textbooks

Practically every course uses a textbook to help convey the basic principles of knowledge. Because textbooks are prepared by college teachers and publishers who are bound by high academic standards and traditions, textbooks reflect the expert wisdom and professional discipline that are an essential part of education.

The purpose of this booklet is to help you understand how to read the technical material you will find in your college textbooks. We cannot promise any magical shortcuts. Learning technical subjects—mathematics, engineering, science, psychology, medicine, and so on—requires patience, concentration, and effort. Even so, if you are willing to spend time studying (and thinking about) how and why we use tables, formulas, symbols, and similar technical information, you will begin to understand that reading technical materials isn't as difficult as you thought when you first browsed through your new textbook.

What Is Technical Material?

There are many different types of "technical material." Generally we use the phrase when we refer to quantitative information or mathematical and scientific symbols. Technical material is specialized material.

Academic and scientific fields use technical material to "tell" us something: to convey a concept; to organize facts; to present findings. The things being told are quantitative; that is, they are scientifically measurable. The information is not expressed in a verbal language as in everyday writing, but in a symbolic language, much like music.

Technical material is also found in newspapers and magazines you may have to read throughout college. In addition, for some courses you may be required to read articles in the scholarly journals where technical material abounds. Indeed, once you become accustomed to technical material you should find that it can be read in the same way as you used to read the comics. As a child with comics, you built a story or received a message from picture symbols. If you can learn to see the technical information in your texts as you learned to see the stories in the comics, then you are off to a good start.

USES OF TECHNICAL MATERIAL

* Compares material
* Shows relationships
* Expresses many quantities
* Describes trends or patterns
* Displays calculations

BENEFITS OF TECHNICAL MATERIAL

* Easy to read
* Versatile
* Compact
* Visual
* Quick

You may even find that the presentation of technical material is a puzzle you enjoy, as the table or chart begins to reveal new and sometimes exciting information you've never thought about before.

Recognizing Technical Material

Shortly after you start reading through your textbook, you will recognize that certain information is grouped or patterned. Parts of your textbook introduce topics, explain ideas, list important facts, summarize, and raise questions. Each part contributes to the textbook's effectiveness.

There are many formats for presenting technical material. Each has in common the use of an abbreviated style that does not involve phrases or text sentences. However, within this shorthand language complete ideas are conveyed. The formats range from equations, theorems, and formulas to tables and graphic illustrations. Vocabulary and special expressions vary from subject area to subject area, but technical material fits standard formats and uses similar devices regardless of subject area.

Symbols

One of the first technical devices you learn as a child is numbers—3 is a symbol for the word or concept "three." Later on you use other numerical symbols readily, you perform operations with symbols, and you use other standard symbols and signs:

2 + 2 = 4	$3.50	H_2O
100%	78°F	6x(y - 1)

In other cases, symbols can stand for something else. They frequently mean something abstract, such as the red-white-and-blue stars-and-stripes flag being a symbol of the U.S.A. or the dove being a symbol of peace.

In college courses dealing with technical material, the symbols you will need to master show concepts and relationships. They are a language of quantities and operations as well as qualities and elements. As this specialized language, symbols appear in equations, theorems, and formulas.

Equations

An equation is a statement of the equality of two operations. In algebra, "unknown" symbols stand for values or qualities, such as x + y = z. As material becomes more complex, equations still state equalities. They always do. The equals sign is like a verb connecting the subject and the object of the verb:

We *love* algebra.

1 gallon = 4 quarts

In some subject areas, you will notice that Greek letters are used as operations symbols or as unknowns. Dictionaries list Greek letters under the heading "Alphabet," a helpful reference to look up the meaning of these symbols.

Mathematical operations symbols are plentiful throughout many college courses—from the familiar square root $\sqrt{\ }$ to the superscript^3 (meaning "cubed") to the complex equations, such as:

$$f(x) = \frac{2!}{x!(2-x)!}\left(\frac{1}{6}\right)x\left(\frac{5}{6}\right)(2-x)$$

Formulas

A formula is a general rule or principle expressed in symbols. Often a formula expresses a chemical composition, or the elements of a substance:

CH_2 is the formula for carbon dioxide

In chemical formulas, the letter (or letters) symbols abbreviate the chemical element and the number symbol refers to the quantity of that element.

CH_2 C = Carbon
H = Hydrogen

One part Carbon plus two parts Hydrogen.

H_2O H = Hydrogen
O = Oxygen

Two parts Hydrogen plus one part Oxygen, which equals water.

Each chemical element possesses a mathematical value—either plus or minus. Your chemistry textbook lists the standard symbols used for all chemical elements as well as the chart of values for each element.

Theorems

A theorem is a statement, or a proposition, that evolves from a series of formulas or from an equation. This means that a somewhat longer and different process is involved, and that is called deduction.

If we have the equation $x = a$
And we have the equation $y = b$
Then we deduce the theorem $x + y = a + b$

Placement of Symbols in Textbooks

In textbooks, equations, formulas, and theorems appear within text sentences or can be set apart, especially if they are long or complex. Frequently when set apart, they are numbered for reference and discussion purposes.

Theorem 2.1

For 3 sets A, B, and C, if ABC and BCC, then ACC. This is known as a transitive property.

Tables

Quantitative information frequently appears in tables. For accuracy and precision of numerical data, a table is the best means of presentation. The simplest tables are read within the framework of a single sentence. For example, the population of the United States increased 13.3% in the ten years from 1960 to 1970, according to the Census:

1960	1970	% change
179,323,175	203,235,298	13.3

In this example, the descriptive variables are given in text form, and the numerical information is listed by category. An in-text table is usually made up of a few items, and is not often more than three columns wide.

More numerical information than can be squeezed into a sentence finds expression in the separate table. If we wanted more detail about the changes in the U.S. population from 1960 to 1970, we would refer to Table 1.

Table 1. Population of the United States, 1960-1970
(By region, based on Census data)

Region	1960	1970	% Change
Northeast	44,677,819	48,999,999	9.7
Northcentral	51,619,139	56,577,067	9.6
South	54,973,113	62,798,347	14.2
West	28,053,104	34,809,359	24.1
Total	179,323,175	203,235,298	13.3

Source: *The World Almanac & Book of Facts 1970*, page 206.

Reading a table may seem like hard work, but once you understand how tables are put together, you can skim the details quickly and get a good general idea of the data presented.

Tables need titles to tell you what the table is about and how the data are grouped. Many tables require additional information to help convey the basic parameters. See if you can identify any of these elements in Table 1:

— *Headnote:* Helps to explain the title; can be considered a sub-title.

— *Source Note:* Acknowledges the origin of the data.

— *Footnote:* Explains something about the method used or about the means of collecting the data or qualifies a number or term.

Columns and *rows* are the pattern in which tables appear. Both columns and rows need *headings* to enable you to read them down or across. Columns are read downward (north-south) in a vertical pattern. Rows are read across (west-east) in a horizontal pattern. Row and column headings tell you the nature of information or the type of data given. When you read the data in the body of the table, you frame it in the context of the column and row descriptors.

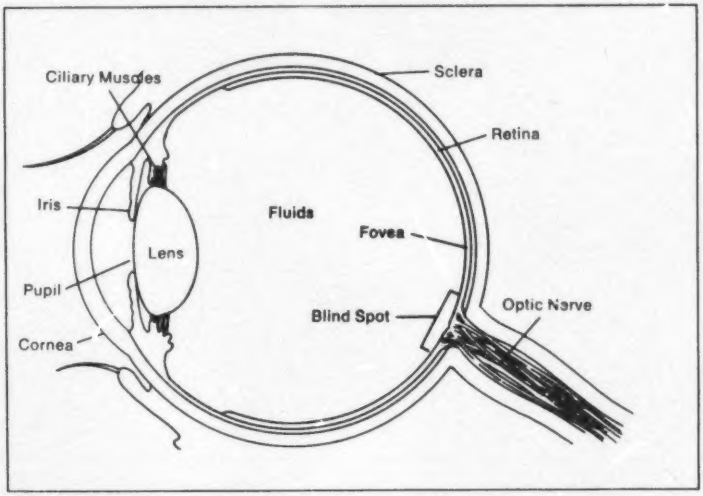
You should read a table slowly at first. Once you understand the title and headnote (if any), proceed to the column and row headings. Skim through the body of numbers. Here is where you can begin to see numbers in relation to one another. You should compare them, looking for highs, lows, and middle ranges. Look for patterns and congregations. Think about what the numbers mean when interpreted in different ways. In Table 1, for instance, we see that in every region of the United States the population has grown from 1960 to 1970. But, we see that the percent of growth is by far largest in the West. We see that the Northeast and Northcentral states changed at about the same rate. The West, however, grew by almost three times the growth of the Northcentral states. No doubt, if we had the Census figures for each state, we could make many more comparisons and observations.

When you read tables in your college textbook, try to draw some conclusions about the influences of one factor or several factors on others. Tables efficiently convey much specialized information and they avoid the monotony of long descriptions.

Illustrations

There are several types of illustrative materials for technical information presented in textbooks. Among the simpler types are diagrams and maps, which you have no doubt encountered in your high school textbooks. Explaining the parts of the human eye can best be explained in a diagram that labels each part. This diagram shows the structure of the human eye in horizontal cross-section.

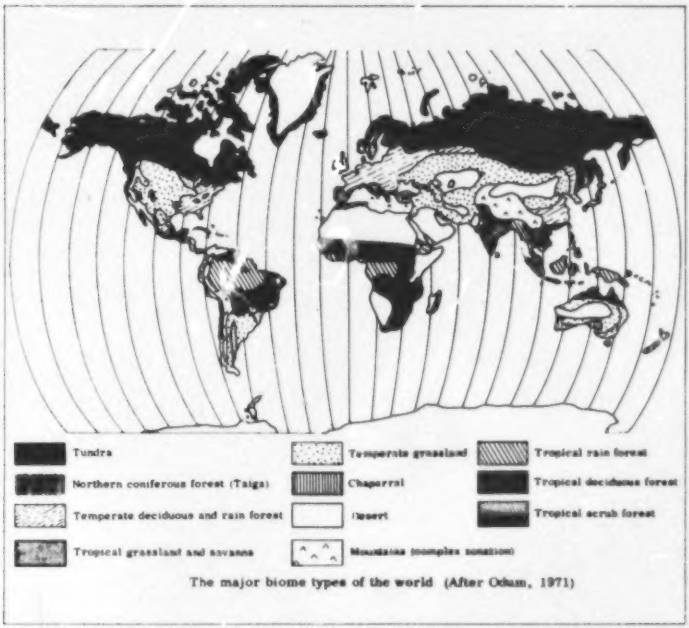
FIGURE 1: An Example of a Diagram



Source: Mischel and Mischel, *Essentials of Psychology*, page 141.

Maps also present information in a straightforward manner. The following map takes a complex geographical entity—the world's major biomes (ecological communities)—and clearly lays them out for the reader.

FIGURE 2: An Example of a Map



The major biome types of the world (After Odum, 1971)

Source: Sutton, *Ecology: Selected Concepts*, page 231.

Illustrations of technical material are usually referred to as *figures*. Figures appear with *captions*, which are similar to table titles but usually longer and more detailed. The four basic styles of figures are:

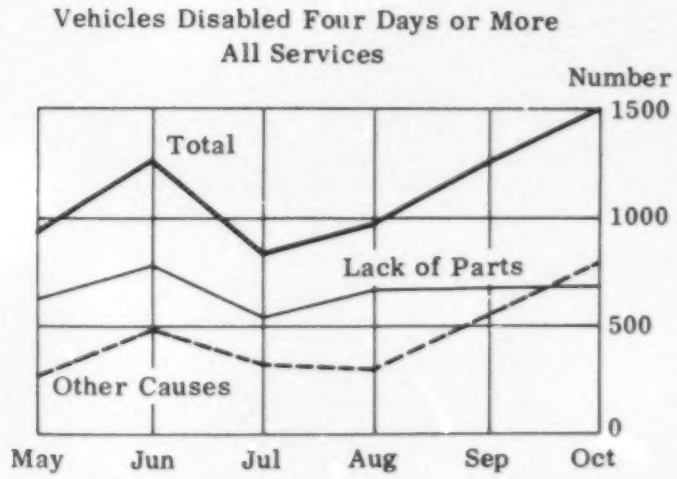
1. Line graph
2. Bar graph or bar chart
3. Pictograph
4. Pie chart or circle chart

Line Graphs

Line graphs show a continuous flow of data from point to point. The purpose of a line graph is to depict a trend or pattern, and not to portray precise quantities along the line.

The points of a line graph are plotted from factual information. Plotting of points involves measurement of two separate bases of data, or two variables. Along one scale, the horizontal, called the *x-axis*, a unit of measurement is identified, for example, in the graph below, months of the year. Along the vertical scale, called the *y-axis*, is another unit of measurement—the numbers of disabled vehicles—that is to be compared to the first one. Here is an example of a line graph. It plots the trends in total disabled vehicles and reasons why they were disabled.

FIGURE 3: An Example of a Line Graph



Source: Selby, *Using Graphs and Tables*, page 44.

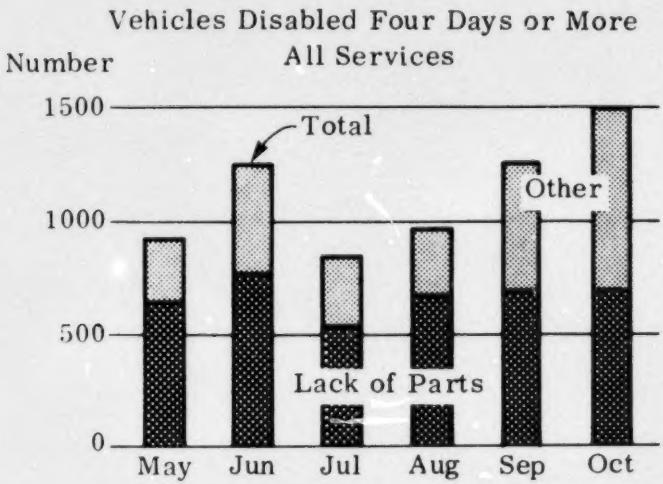
By looking at the graph, we can see that there is an upward trend in disabled vehicles from July through October, and that the Total and Lack of Parts curves don't always move together. It is not important to have the exact numbers in each case; rather, it is the trend that you should notice.

In mathematics, line graphs are used to plot equations; several can appear on an x-y axis. The value of one quantity (y) varies with the value of another quantity (x). Once an equation is plotted on a line graph format, any point can be located and given a numerical value by its x and y measurements, which are called the *coordinates* of the point.

Bar Graphs or Bar Charts

Technical information conveyed by bar graphs can be used for easy visual comparison. Vertical or horizontal bars correspond to the plotted points of a line graph. However, precise scaled x and y axis are not necessary. Figure 4 uses the same information as Figure 3, but is designed to emphasize the total and the composition of the total by cause. By comparing the lengths of the vertical bars we can easily see trends in the Total and in the Lack of Parts. The changes in Other are not as easy to read, and a direct comparison of the causes is not given.

FIGURE 4: An Example of a Bar Graph.

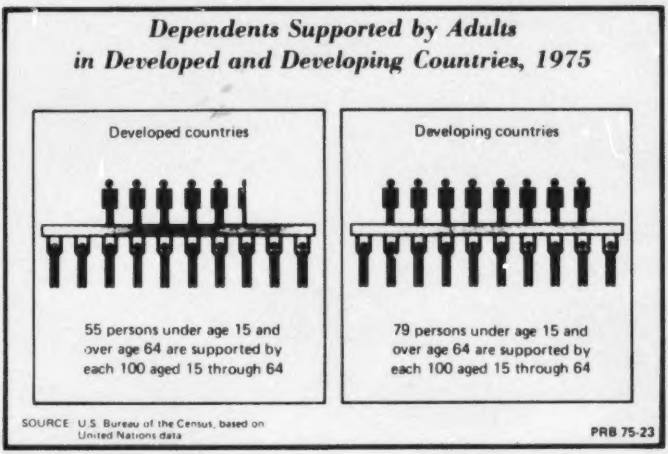


Source: Selby, *Using Graphs and Tables*, page 43.

Pictographs

Many newspapers and news magazines, as well as textbooks, use pictographs to command the readers' attention. Although they are basically bar graphs, pictographs use picture symbols to represent quantities. A complete picture symbol corresponds to a specified quantity; a larger picture or a complete-plus-extra picture means a larger quantity; a smaller picture or a partial picture means a smaller quantity. Look at the following pictograph. Each figure represents ten people. The pictograph makes it easy for us to see that slightly more than three-fourths of the developing world population are in the dependent category (below age 15 and above age 64), while in the developed world, there are 55 dependent persons for every 100 adults.

FIGURE 5: An Example of a Pictograph

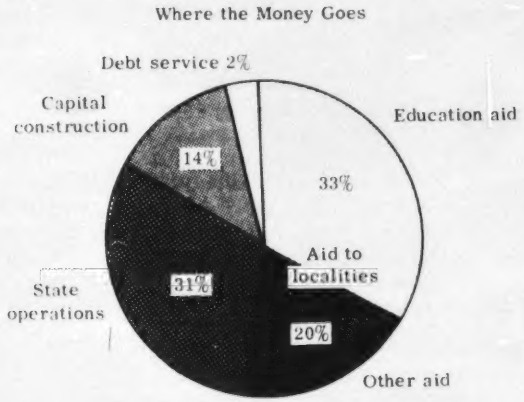

Dependents Supported by Adults
in Developed and Developing Countries, 1975
Developed countries
55 persons under age 15 and over age 64 are supported by each 100 aged 15 through 64
Developing countries
79 persons under age 15 and over age 64 are supported by each 100 aged 15 through 64
SOURCE: U.S. Bureau of the Census, based on United Nations data
PRB 75-23

Source: Population Reference Bureau, *World Population Growth and Response*, page 204.

Pie Charts or Circle Charts

Pie charts represent quantities that can be divided into percentage "slices," with the total "pie" equal to 100 percent. It may be more difficult to plot a pie chart because the total circle, which measures 360 degrees, must be converted to 100 percent, and each portion of the pie must be calculated as a percentage and then converted back to degrees for plotting purposes. On the other hand, a pie chart can show at a glance certain relationships between variables. In the following figure, which shows where state tax money goes, we can easily see that over half of the expenditures are in aid to localities.

FIGURE 6: An Example of a Pie Chart



Source: Selby, *Using Graphs and Tables* page 136.

Conclusion

After learning the techniques of reading technical material, you should be able to approach your technical textbooks with confidence and ability. Remember—tables, equations, charts, and so on, are used to help you more easily understand the disciplines you are studying.

This booklet is one in a series of AAP STUDENT SERVICE articles developed for the college textbook publishers to help students improve their use of study time and learning materials. Titles of the other booklets can be found on the back cover.

Studying is an essential aspect of education—representing a large investment of time and money. Like driving, athletics or any other activity, it requires practice and concentration. To study well it is important to know how to make maximum use of the books and facilities that are available. The enjoyment of learning and the retention of knowledge depends in great part on developing good study skills and learning habits.

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